THE EMPLOYABLE INNOVATIVE STRATEGIES FOR POLLUTION CONTROL AND FACTORY CONSCIOUSNESS WITHIN TURKEY- TOWARDS ZERO CARBON

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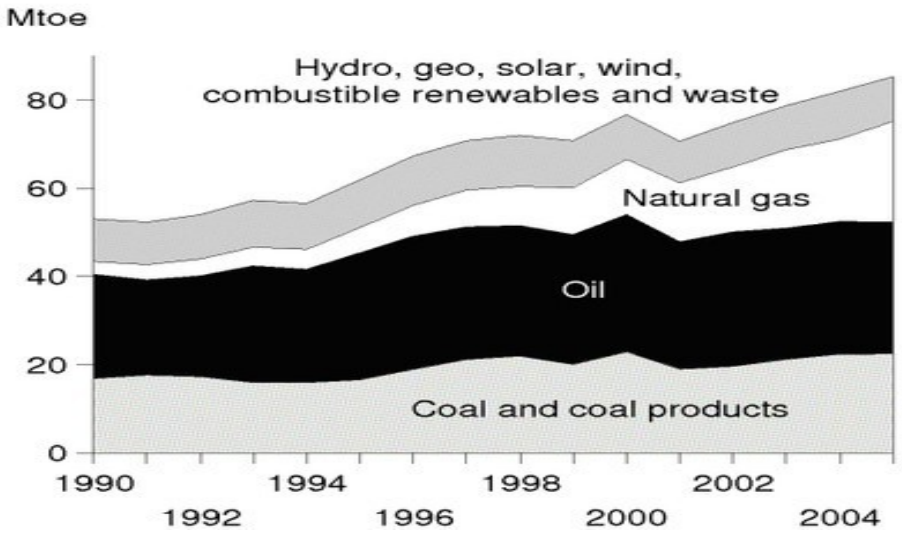
1- Managing Air Quality - Introduction and summary of Pollution Reduction Initiative for Turkey

Initially it would be better for anyone who intends to contribute to air quality - any country- in the world must know that that the way to this goal comes with some kind of consciousness. On this context a control strategy related to air quality is a set of determined techniques and measures identified and implemented to attain reductions in air pollution to attain an air quality standard or goal. Below there are some topics wherein explanation is available for clearance about what the problem is and beyond.

As stated air pollution is one of the most significant problems in Turkey like other countries. The main reasons for this could be summed up as; rapid increase of population, energy consumption due to industry and housing and increasing fuel demand for vehicles.Trends in sulphur dioxide and particulate matter concentrations in some metropolitan cities of Turkey are given above. While these graphics are examined, in general, decrease in the major pollutants has been observed. Trends in reducing annual average concentrations of SO2 and particulate matter in cities showed overall progress between 2002 and 2008. In cities such as İstanbul, Ankara, Gaziantep, Samsun, Sivas and Diyarbakir pollutant concentrations highly decreased, particularly during winter seasons, in some cities from levels over 260 µg/m3. This progress reflects major changes in energy supply for domestic heating, with natural gas substituting for coal in a number of cities and prohibition of the use of high-sulphur coal in 2005. Average annual concentrations of SO2 and PM10 are below the long-term target limit value Average winter concentrations have exceeded long-term target limit value, and average concentrations of SO2 and PM10 have remained above the WHO guideline of, respectively, 20 and 50 µg/m3. Urban air pollution is a significant environmental problem for Turkey, as is common in developing countries. Economic growth and rapid urbanization has brought with it serious air pollution problems. Average annual growth rate of urban population was 2.30% in the period of 1990–2013 and at the end of 2008, 72.37% of total population lived in urban areas. Three largest metropols, namely Istanbul, Ankara, and Izmir provinces, are resided by 30.42% of the country’s total population. Starting with the second half of 1970s, especially in the winter months, urban air pollution has become a significant problem. In the 1990s, there has been a decrease in concentrations of sulphur dioxide (SO2) and particulate matter (PM) in urban areas. Most of this improvement can be attributed to fuel substitution (from high sulphur content domestic coal to natural gas) in residential heating and power generation. However, in some urban and industrial centers ambient air pollution still poses a threat to public health since SO2 and particulates exceeding national air quality standards]. While pollution concentrations are highest in major urban areas (Istanbul, Ankara) and cities where industry has continued to expand, in rural areas air quality is typically good. Turkey’s environmental policy has been shaped by international regulatory frameworks. Of particular importance here is the EU. As a candidate state to the EU, Turkey has been harmonizing the national environmental legislation with the EU environmental acquisition. An important impetus to strengthen air management policy in Turkey came when Turkey adopted its EU Integrated Environmental Strategy which called for the full harmonization of the Turkish legal frame work with the EU Air Quality

Framework Directive. Comparison of the Turkish air quality standards with those of the EU shows that for nearly all pollutants the standards are higher than the EU limit values. The only exception is annual mean of SO2 and NOx since the standards for those pollutants are the same from 2014 on. The Ministry of Environment and Urbanization is working on improving the air quality management scheme in Turkey. Since 2012, air quality data have been available in a new format. They come from 195 stable air quality measurement stations and four mobile air quality measurement stations in the context of National Air Quality Observation Network program. The data are made available in real time to the public through the Ministry of Environment and Urbanization website. However, both the number of parameters measured and the availability of retrospective data are still limited. The next step, necessary, is to present some information about its perilous effects on human side plus Turkish human side.



IMPACTS OF AIR POLLUTANTS ON HEALTH RESPIRATORY SYSTEM
Effects aligned: increased respiratory symptoms as well as infections; increased airway reactivity, irritation; lung inflammation; increased respiratory mortality and hospital visits, hospitalization; decreased lung function, asthma exacerbation, exacerbation of chronic obstructive pulmonary disease (COPD), and increased lung cancer risk. The US American Thoracic Society identified a wide range of respiratory health effects associated with air pollution that should be considered “adverse”, spanning outcomes from death from respiratory diseases to reduced quality of life, and including some irreversible changes in physiologic function. Studies show that lung function growth in children is reduced in areas with high PM concentrations1o ; and this function either improves when children are relocated to areas with lower air pollution, or deteriorates when children move to areas with greater air pollution. This effect on lung development is an additional risk factor for developing lung diseases later in life. Air pollution exposure can trigger new cases of asthma, worsen a previously-existing respiratory illness, and provoke development or progression of chronic illnesses including COPD, emphysema and lung cancer. COPD is a life-threatening lung disease that interferes with normal breathing. The number of deaths from COPD has increased more than 60% over the last 20 years, and air pollution is an important risk factor through inflammation, an immunological response. The inflammatory response is referred to as chronic bronchitis. In the air cells it leads to destruction of tissue, or emphysema. Under the light of this solid knowledge, a scientific outcome would be the urgent step to take on precautionary actions. This project aims nothing save that. Turkish Neurological Society

representative Assoc. Prof. Semih Ayta stressed the impact of air pollution on peoples' genes.
"The effect of air pollution on our genes is not equal in all periods of life. The susceptibility to the effects of particulate matter increases in pre-pregnancy, the period in the womb, early childhood and old age.
"Studies on child patients show that air pollution triggers asthma attacks as a result of its effect on genes. Also, new studies have shown that exposure to particulate matter is associated with mental illness such as depression, "he said." n 2017, 203 stations were active on air quality observation nationwide. Although all stations measured PM10, only 180 of the stations (89%) held data for more than 75% of the year. There were not enough data to analyze the provinces of Muş, Şırnak, and Uşak. The highest values were found in Amasya (Şehzade) (319 µg/m3), Bursa (316 µg/m3), Manisa (314 µg/m3), Adana (Meteoroloji) (309 µg/m3), Denizli (Bayramyeri), and Niğde (289 µg/m3) stations. Of the 180 stations with sufficient data, 156 stations (87%) recorded daily PM10 average values above 50 µg/m3 for more than 35 days in the year. In 2017, the PM10 values in all the stations except for the one in Artvin (99.4%) were above the value set by the WHO. The nationally regulated limit value was 48 µg/m3 in 2017 and it was exceeded in 52 provinces (66.6%). In 2019, there were 338 stations active in air quality observation nationwide. Although all the stations measured PM10, only 177 of them (52%) held data for more than 75% of the year. The proportion of stations that made measurements for more than 75% of the year were 78% in Istanbul, 44% in Bursa, 40% in Izmir, 30% in Ankara and Zonguldak, 29% in Denizli and Konya, 22% in Manisa, 14% in Gaziantep and Muğla. There were no enough data for the analysis of Ağrı, Artvin, Batman, Bayburt, Bolu, Mersin, Tunceli, and Uşak. The highest values of PM10 were found in Muş (136 µg/m3), Iğdır (87 µg/m3), Şırnak (81 µg/m3), and Kahramanmaraş (75 µg/m3) stations. In 2019, the limit value permitted by the WHO was exceeded in all the stations except for the ones in Hakkâri and Hatay (99.4%). The national limit value in 2019 was 40 µg/m3 and it was exceeded in 52 provinces (71.2%)

Rationale

As highlighted in recent researches, fluids geochemistry has an important role in determination of active tectonic lines, monitoring of seismic activity and in constraining the origin of thermal fluids including their relation with the tectonic setting. Although some 2 important researches about the extension of sinistral S-N elongated DSFZ (Dead Sea Fault Zone) in the Amik Plain have been carried out (Rojay vd., 2001; Akyüz vd., 2006; Altunel vd., 2009; Karabacak vd., 2010), the exact location of this fault, its Northwards elongation, and other tectonic structures crossing the Plain are still unclear. Moreover, the SW extension of the Karasu Fault, connecting the DSFZ and SAFZ (South Anatolian Fault Zone) and the relationships of the thermal waters discharging in the Amik Plain with the volcanic rocks outcropping along the Kırıkhan-Reyhanlı corridor the Karasu Fault and other active faults (Kop, 1996) are still open and debeated questions. This proposal aims (i) to trace the extension of the DSFZ until the Karasu Fault, (ii) to better understand the thermal waters/active fault relationships and (iii) to recongize other structures (if any) parallel related to the DSFZ. The fluids geochemistry will reveal possible magmatic or mantle origin of gases, the origin of thermal waters, their interactions and relationship with active faults. The latter information will also contribute to assess the geothermal potential of the region. Scope The DSFZ is a large tectonic structure crossing Jordan, Israel, Syria and Turkey following a nearly N-S direction. As the DSFZ is one of the most active structures of the whole region, the scope of the project is to characterize the Turkish-Syrian section of the fault as its contributions to reduce natural disasters of geologic origin. The presence of thermal waters at

some areas located along the fault , increases the validity the project as it is also a source of information for geothermal potential evaluation purposes.To reach this target, a geochemical approach will be followed The DSFZ is one of the most active tectonic structures of the region crossing Jordan, Israel and Syria following a nearly N S direction. The DSFZ goes along the Asi river in the Amik Plain of Turkey (fig. 1). A geochemical approach will be adopted for the determination of the northern extension of the DSFZ and the SW extension of KFZ by soil-degassing measurement of CO2, Rn and CH4. Since the SW side of the Amik Basin includes a number of thermal water discharge locations potentially related with the Kırıkhan-Reyhanlı corridor and thermal waters are also discharged along the WNW-ESE trending faults extending outside the country located to the South of the Reyhanli town and SE of the Amik Plain (Reyhanli dextral Fault; Şaroğlu vd. 1987) information related to the geothermal potential of the area can be additional results of the geochemical approach of the project. Soil degassing measurements coupled with water geochemistry studies will be carried out in the west-middle West of Amik Plain, close to the boundary of Syrian. This study will include the Reyhanlı Hamam (Hamamat) thermal spring (t= 37 oC), Borniyaz mineralized water well (t=25 oC), Kırıkhan Ilıpınar spring, Reyhanlı- Yenişehir ve Cüdeyde cold water springs and KırıkhanReyhanlı hot water wells (Fig.1 and Table 1). Within the scope of this study, the continuation of DSFZ to the Karasu Fault, the extension of the Karasu Fault in SW direction, the relation of volcanics outcropping along the Karasu Fault with geothermal activity and the origin of thermal waters will be determined by carbon and helium isotope composition of the dissolved gases and isotope composition (δ18O, δ2H ve 3H), major, minor and trace ion analyses in water

In this regard, one should be careful condescending this project,supporting it. The project will be developed using geochemical technologies. In the following, methods and techniques adopted for both the fieldwork and laboratory analyses are described: Soil CO2, radon and helium gas flux anomaly mesaurement is known as an useful method to locate active and buried faults under alluvium cover. There are numerous studies showing that high He and CO2 and/or Rn contents are good indicators of fault degassing. Moreover, soil and groundwater gas geochemistry studies also play an important role in geothermal potential studies in hydrothermal areas. Measurment of gas discharges can easily discriminate permeable and/or impermeable zones. It is for sure that this kind of study should be integrated with other geophysical/geologic data. Fieldwork The fieldwork will provide the information about the soil-degassing activity (CO2, Rn and CH4) and allow the collection of samples to be analyzed in the laboratory. The fieldwork will be developed using GIS-type software to allow the correct location of the sampling sites and the nodes of the degassing grid measurements on georeferenced maps. This project proposal comprises the following methods for investigations aimed to measure the natural degassing rate from selected areas and to collect gas and water samples:

1- Soil degassing measurements will be carried out over an almost regular grid (side of 2.5km) accross the areas where buried faults are supposed to exist. The measurements will be repeated two times a year, especially at locations where initial gas emmisions are high, so as to be able to monitor its relations with the seasonal variations and microseismicity.

2- The spacing of profiles are proposed as 2.5 km, and could be reduced to 1 km where Table 2. Measurement and Analysis Methods in the project gas anomalies can be observed. Furthermore, dissolved gases and chemical and isotope composition of

groundwaters taken from shallow/deep wells and springs from the studied areas will be analyzed in order to understand possible relations with buried fault zones. Soil-CO_2 gas flux will be measured by a portable instrument composed of a chamber connected to an Infrared spectrometer (WEST Systems, Italy). A small, pocket size, computer (PDA) manage the instrument, showing the result(s) of measurement in real time. The fluxmeter is equipped with the LICOR LI-820 the most accurate and reliable portable carbon dioxide detector. The LI-820 is a double beam infrared sensor compensated for temperature variation in the range from -10 to 45°C and for atmospheric pressure variation in the range 660-1060 HPa. Accuracy 2% repeatability ±5ppm. The full scale range can be set to 1000, 2000, 5000 or 20000 ppmV of carbon dioxide. The characteristics of precision refer to the sensor set to a full scale range of 20000 ppmV. If a very high sensitivity is required the 5 detector can be set to 1000 or 2000 ppm full scale value. The instrument, which is in the shape of a closed semi-circle of 30 cm diameter, has a height of 20 cm and resembles a reversed pot. When it is mounted on the measured surface, the measurement is made by driving in the edges of the pot into the soil so as to provide airtight. In the mainframe of the the project the instrument will be donated by the Italian partner Measurement Location materials to be analyzed Type of Analyses Parameter Number of sample or measureme nts/ Period *Total of the sample or measure ments Applied Methods In Field in Lab A- Physical Analysis Temperature (oC) ,pH,Eh (Redox Potential), EC,DO,Salinity, Alkalinity, GWL 50/4 200 Multi parameter measurement device, YSI 556 model, Alkalinity kit In both locations Ca, Mg, Na, K, Cl, SO_4, HCO_3, CO_3 50/4 200 --- H.U. Water Chemistry Laboratory (Ankara) WATER B- Chemical Analysis Heavy metals (Cu, Zn, Pb, Cd), pollution parameters (NO_2, NO_3, NH_3) and total Fe, B, Br, As, F, I, SiO_2 such as the other parameters 50/4 200 Ca^{2+}, Mg^{2+}, Na^{+} ve K^{+} analysis are measured with atomic absorption spectrometer, SO_4^{2-} is measured by spectrophotometer, alkalinity is measured by standard titration technique, Cl^{-} anion is measured by silver-nitrate titration technique --- NTU (TAIWAN) and INGV (ITALY) 3H 50/2 100 Tritium measurements are made by Liquid scintillation technique. H.U. Water Chemistry Laboratory (Ankara) WATER δ 18O, δ2H 50/2 100 Oxygen-18 and Deuterium ısotope analysis are made by mass spectrometer, 13C/12C, δ13CCO_2 50/4 200 CO_2 İsotope Analyzer (LGR), IsoCO_2 CRDS (Picarro) SOİL GAS +WATER C- İsotopic Analysis 3He/ 4He, 4He/20Ne, 40Ar/36Ar 50/4 200 Micromass 5400 Noble Gases Mass Spectrometer; GVI5400TFT mass spectrometer; GVI Argus MS --- NTU (TAIWAN) and INGV (ITALY) SOİL D- Radioactivity Analysis in Soil 238U, 232Th, 40K 10/1 10 Gama Spectrometer --- NTU (TAIWAN) Rn (200+50)/2 500 Ionization chamber (GEO-RTM 2128 and Alphaguard PQ2000PRO) On the Field --- CO_2, CH_4 (200+50)/2 500 IR spectrometer (WEST LI-820) On the Field --- Helium (4He) (200+50)/2 500 Helium Leak Detector (Alcatel ASM 102S) On the Field --- SOİL GAS +WATER E-Gas Analysis Ar, N_2, CO_2 , CH_4, 4He (50+50)/2 200 Micro GC and Noble Gas MS On the Field NTU (TAIWAN) and INGV (ITALY) and for atmospheric pressure variation in the range 660-1060 HPa. Accuracy 2% repeatability ±5ppm. as a standard for calibration. In general, the total errors on the ratios are less than 2 and 5% in one sigma standard deviation, respectively, for 3He/4He and 4He/20Ne. Details of the procedures are found in Yang et al. (2005). The isotopic analyses of the purified helium fraction will be performed by a static vacuum mass spectrometer (GVI5400TFT) that allows for the simultaneous detection of 3He and 4Heion beams, thereby keeping the 3He/4He measurement error to very low values. Typical uncertainties in low3He samples (R/Ra values below 0.1) are within ±5%. mass spectrometer following a specific procedure based on the chemical and physical stripping of CO_2. The stripped gas is purified by means standard procedures. The samples 8 will be measured using a Finnigan Delta Plus mass spectrometer and the results expressed in □ ‰ vs. V-PDB standard. The standard deviation of 13C/12C

ratio is ± 0.2‰. Fig. 2 Soil-gas measurement model Sampling and analytical procedures of water samples Water samples will be collected in order to achive more.

3- WHY IS THE ENERGY SECTOR RELEVANT FOR AIR POLLUTION IN TURKEY?
This topic should also be tackled also. In every country, the energy sector is an important source of air pollution. An analysis of the EEA shows that energy use and supply is responsible for 48% of emissions, 35% of non-methane and 99% of sulphur dioxide (SO2) emissions7 . These pollutants can contribute to the formation of particulate matter and ozone, the two pollutants most worrying for health. Coal power plays a central role in Turkey's energy system. But coal power plants release substantial amounts of particulate matter, sulphur dioxide, and nitrogen oxides. Other hazardous substances emitted from the smokestacks of coal power plants are heavy metals, such as mercury, and persistent organic pollutants, such as dioxins and poly cyclic aromatic hydrocarbon. Special concern for children's health arises from the large mercury emissions from coal power plants. A large coal power plant emits several thousand tons of hazardous air pollutants every year and has an average lifetime of at least 40 years. Building new coal power plants would mean that hazardous emissions and their effects on health would continue for many years. Emissions from coal power plants in Europe contribute significantly to the burden of disease from environmental pollution. The brand-new figures published in Heals report show that EU-wide impacts amount to more than 18,200 premature deaths, about 8,500 new cases of chronic bronchitis, and over 4 million lost working days each year. The economic costs of the health impacts from coal combustion in European Union are estimated at up to €42.8 billion per year. So, well. What can be done for this confrantation? Solution comes form precautional knowledge, exactly.

So other projects practised so far has not attained enough success due to their inefficient management system. They might have been set forth the implementation point. However they had been left on the shelf. just documentized. This very project has adopted these strategies.

Air Quality Control Strategy
Environmental factors such as ambient air quality conditions, relevant meteorological conditions, location of the emissions source, noise levels, and any ancillary pollution from the control system itself.
Engineering: factors such as pollutant characteristics (such as abrasiveness, reactivity and toxicity), gas stream characteristics, performance characteristics of the control system, and adequate utilities (for example, water for wet scrubbers). Shortly. Air will be kept under control.
Economic factors such as capital cost, operating costs, equipment maintenance, equipment lifetime, and administrative, legal, and enforcement costs will be regulated.
The controlling sources of pollution directive 1.Reduce, eliminate, or prevent pollution at its source, should be considered. Examples are to use less toxic raw materials or fuels, use a less-polluting industrial process, and to improve the efficiency of the process.
The Clean Air Technology Center serves as a resource on air pollution prevention and control technologies, including their use, effectiveness and cost. Examples are mechanical collectors, wet scrubbers, fabric filters (baghouses), electrostatic precipitators, combustion systems (thermal oxidizers), condensers, absorbers, adsorbers, and biological degradation. Controlling emission related to transportation can include emission controls on vehicles as well as use of cleaner fuels.Economic incentives, such as emissions trading, banking, and emissions caps

can be used as well. These strategies may be combined with the "command-and-control" type regulations which have traditionally been used by air pollution control agencies.

Need for Controls Applied Regionally or Nationally in Addition to Locally

Air pollution does not recognize geographic boundaries. Some pollutants can travel great distances affecting air quality and public health locally, regionally, nationally, and even internationally in areas that are downwind.

For this reason, control strategies to improve air quality in local areas need to include control measures that are mandated and implemented on a state, region-wide or national basis. In general, regulations established by the national government tend to have the widest application, which can minimize boundary and economic competition issues.It identifies measures to control sources of pollution and tries to develop a control strategy and plan that incorporates the control measures. The written plan should include implementation dates. The plan will need to reference the requirements that owners or operators of emission sources will need to undertake to reduce pollution contributing to the air quality problems. It involves the public and invites input from the regulated community and others, including the general public when developing the control strategy. This early consultation reduces later challenges and can help streamline implementation. It includes compliance and enforcement programs. These programs are very important to include and help owners or operators of sources understand the requirements, as well as the actions that environmental authorities can take if the sources don’t comply.

Actions under the project include

Follow these Tips Every Day to Reduce Pollution:

Conserve energy - at home, at work, everywhere.

Look for the ENERGY STAR label when buying home or office equipment.

Carpool, use public transportation, bike, or walk whenever possible.

Follow gasoline refueling instructions for efficient vapor recovery, being careful not to spill fuel and always tightening your gas cap securely.

Consider purchasing portable gasoline containers labeled “spill-proof,” where available.

Keep car, boat, and other engines properly tuned.

Be sure your tires are properly inflated.

Use environmentally safe paints and cleaning products whenever possible.

Mulch or compost leaves and yard waste.

Consider using gas logs instead of wood.

On Days when High Ozone Levels are Expected, Take these Extra Steps to Reduce Pollution:

Choose a cleaner commute - share a ride to work or use public transportation.

Combine errands and reduce trips. Walk to errands when possible.

Avoid excessive idling of your automobile.

Refuel your car in the evening when its cooler.

Conserve electricity and set air conditioners no lower than 78 degrees.

Defer lawn and gardening chores that use gasoline-powered equipment, or wait until evening.

On Days when High Particle Levels are Expected, Take these Extra Steps to Reduce Pollution:

Reduce the number of trips you take in your car.

Reduce or eliminate fireplace and wood stove use.

Avoid burning leaves, trash, and other materials.

Avoid using gas-powered lawn and garden equipment.

You can also take steps to minimize your exposure to air pollution and protection your health.

. Data and Methodology 3.1. Data Sources A variety of air quality parameters are used in the development of air quality index. Sulphur dioxide (SO2), nitrogen dioxide (NO2), particulate matter (PM10), carbon monoxide (CO), and ozone (O3) are the common ones. In this study, pollutants were selected based on the availability and continuity of data at the air quality monitoring stations. According to this constraint, SO2, NO2, and PM10 were the parameters of concern. The data were collected from Republic of Turkey Ministry of Environment and Urbanization, “Air Quality Monitoring Stations” website [17]. Despite there are 199 air quality measurement stations overall Turkey, the number of stations which supply the yearly average concentrations of SO2, NO2, and PM10 are only 20. Listed following are the stations that were included in this study: Adana-Valilik (S1), Ankara-Bahçelievler (S2), Ankara-Cebeci (S3), Ankara-Demetevler (S4), Ankara-Dikmen (S5), Ankara-Sıhhıye (S6), Ankara-Sincan (S7), ˙Istanbul-Aksaray (S8), ˙Istanbul-Alibeyköy (S9), ˙Istanbul-Be¸sikta¸s (S10), ˙Istanbul-Esenler (S11), ˙Istanbul-Kadıköy (S12), ˙Istanbul-Ümraniye (S13), ˙Izmir-Bornova (S14), ˙Izmir-Güzelyalı (S15), Sustainability 2016, 8, 73 3 of 8 Karabük-Kardemir1 (S16), Karabük-Kardemir2 (S17), Kocaeli-Dilovası (S18), Manisa-Soma (S19), Zonguldak-Karadeniz Ere ˘gli (S20). It should be noted that all selected stations are located near the urban and industrial sites of eight cities. As can be seen from Figure 1, which illustrates annual mean ambient air concentrations for SO2, the EU long-term standard (20 µg/m3) [18,19] was exceeded at four stations. The violation of the European standard can also be observed for NO2 concentrations. At S2, S3, S4, S5, S6, S8, S9, S10, S11, S12, and S13 stations limit value (40 µg/m3) [18,19] was exceeded (see Figure 2). In respect of PM10 concentrations, the situation is much worse. According to Figure 3, the annual standard of (40 µg/m3) [18,19] was exceeded at 18 stations out of 20. Sustainability 2016, 8, 73 3 of 8 Karabük-Kardemir1 (S16), Karabük-Kardemir2 (S17), Kocaeli-Dilovası (S18), Manisa-Soma (S19), Zonguldak-Karadeniz Ereğli (S20). It should be noted that all selected stations are located near the urban and industrial sites of eight cities. As can be seen from Figure 1, which illustrates annual mean ambient air concentrations for SO2, the EU long-term standard (20 µg/m3) [18,19] was exceeded at four stations. The violation of the European standard can also be observed for NO2 concentrations. At S2, S3, S4, S5, S6, S8, S9, S10, S11, S12, and S13 stations limit value (40 µg/m3) [18,19] was exceeded (see Figure 2). In respect of PM10 concentrations, the situation is much worse. According to Figure 3, the annual standard of (40 µg/m3) [18,19] was exceeded at 18 stations out of 20. Figure 1. Annual mean ambient air concentration of SO2. Figure 2. Annual mean ambient air concentration of NO2. Figure 1. Annual mean ambient air concentration of SO2 . Sustainability 2016, 8, 73 3 of 8 Karabük-Kardemir1 (S16), Karabük-Kardemir2 (S17), Kocaeli-Dilovası (S18), Manisa-Soma (S19), Zonguldak-Karadeniz Ereğli (S20). It should be noted that all selected stations are located near the urban and industrial sites of eight cities. As can be seen from Figure 1, which illustrates annual mean ambient air concentrations for SO2, the EU long-term standard (20 µg/m3) [18,19] was exceeded at four stations. The violation of the European standard can also be observed for NO2 concentrations. At S2, S3, S4, S5, S6, S8, S9, S10, S11, S12, and S13 stations limit value (40 µg/m3) [18,19] was exceeded (see Figure 2). In respect of PM10 concentrations, the situation is much worse. According to Figure 3, the annual standard of (40 µg/m3) [18,19] was exceeded at 18 stations out of 20. Figure 1. Annual mean ambient air concentration of SO2. Figure 2. Figure 2. Annual mean ambient air concentration of NO Annual mean ambient air concentration of NO22. . Sustainability 2016, 8, 73 4 of 8 Sustainability 2016, 8, 73 4 of 8 Figure 3. Annual mean ambient air concentration of PM10. 3.2. Methodology Although there are various methods available for constructing air quality indices [20–22], there is

no unified strategy for constructing an air quality index. The objective of this study is to construct a multi-pollutant index considering the combined level of the three pollutants (SO2, NO2, PM10) in view of the EU long-term annual limit values. Therefore, as a first step, normalization should be carried out in order to render the variables comparable [23,24]. A number of normalization methods exist in the literature [24]. In this study, “Distance to Reference Value Normalization” method [24] is applied since this approach is widely used in environmental applications [25–27]. In this method, distance to a reference measures the relative position of a given indicator vis-à-vis a reference. This could be a target to be reached in a given time frame. Turkey’s “Air Quality Assessment and Management Regulation” sets limits for air quality parameters in order to comply with the EU limit values. However, the application of ambient air quality standards shall become effective gradually and the harmonisation process will be completed by 1 January 2022. Since Turkey stated that it was aiming at complying with the EU limit values, in our study these EU long-term limit values were accepted as reference values [16]. The general equation to calculate the normalized value of individual indicator i (i S) is given as follows: □□ □□□ □□(1) □ where □) □µg/m3) is the raw value of individual indicator i and □□□ (µg/m3) is the EU long-term limit value for the indicator i. The calculated normalised values of the air pollutant concentrations for 20 air quality monitoring stations are presented in Table 1. Figure 3. Annual mean ambient air concentration of PM10. 3.2. Methodology Although there are various methods available for constructing air quality indices [20–22], there is no unified strategy for constructing an air quality index. The objective of this study is to construct a multi-pollutant index considering the combined level of the three pollutants (SO2, NO2, PM10) in view of the EU long-term annual limit values. Therefore, as a first step, normalization should be carried out in order to render the variables comparable [23,24]. A number of normalization methods exist in the literature [24]. In this study, “Distance to Reference Value Normalization” method [24] is applied since this approach is widely used in environmental applications [25–27]. In this method, distance to a reference measures the relative position of a given indicator vis-à-vis a reference. This could be a target to be reached in a given time frame. Turkey’s “Air Quality Assessment and Management Regulation” sets limits for air quality parameters in order to comply with the EU limit values. However, the application of ambient air quality standards shall become effective gradually and the harmonisation process will be completed by 1 January 2022. Since Turkey stated that it was aiming at complying with the EU limit values, in our study these EU long-term limit values were accepted as reference values [16]. The general equation to calculate the normalized value of individual indicator i (Si) is given as follows: Si “ Ci Ctv (1) where Ci (µg/m3) is the raw value of individual indicator i and Ctv (µg/m3) is the EU long-term limit value for the indicator i. The calculated normalised values of the air pollutant concentrations for 20 air quality monitoring stations are presented in Table 1. Sustainability 2016, 8, 73 5 of 8 Table 1. Normalized values of the ambient air pollutant concentrations. Station Code SO2 NO2 PM10 S1 0.200 0.575 1.625 S2 0.500 1.500 1.350 S3 0.500 1.550 1.900 S4 0.700 1.175 1.500 S5 0.400 1.575 1.275 S6 0.500 1.400 1.875 S7 0.450 0.875 1.425 S8 0.400 1.850 1.425 S9 0.200 1.375 1.525 S10 0.200 2.100 1.175 S11 0.200 1.525 1.325 S12 0.250 1.350 1.325 S13 2.850 1.325 0.150 S14 0.400 0.525 1.000 S15 0.300 0.525 1.450 S16 1.200 0.775 2.100 S17 2.000 0.625 2.475 S18 0.800 0.925 2.050 S19 3.250 0.725 2.000 S20 0.400 0.925 1.175 Once the normalization process is completed, the weights of the environmental indicators (SO2, NO2, and PM10) must be specified before the aggregation in order to build a single index. The weights can be derived by integrating the expert surveys with some multi-attribute evaluation models such as the Analytical Hierarchy Process [28–31]. If there is no exact expert information or objective mechanism to determine the relative importance of different environmental indicators, the choice of equal weights

may be more justifiable and widely acceptable [19,25,32]. In this present study, equal weights were assigned to all normalized values. Since the normalization process took into account the EU long-term limit values for each indicator, Si values reflect implicitly the magnitude of the health impact of each pollutant. Therefore, the adoption of equal weights is consistent with the aim of the study. The annual average air quality index for a specific station was calculated from the following formula: Is “ ÿ N i“1 wiSi,s (2) where IS represents the aggregated index for the station s, N is the number of indicators to be aggregated, Si,s is the normalized values of the indicators for specific station s for indicator i and wi is the weight of indicator i. w1,w2,w3 were assigned to 1/3 weight, since equal weights were adopted for the three environmental indicators. 4. Results and Discussions The proposed index represents the city’s general air quality conditions throughout the year. It is based on annual mean ambient air concentrations of the pollutants compared to annual limit values. It is presented as a distance to target values. The index provides a relative measure of the annual average air quality in relation to the European limit values, since the target was selected as the EU directives (annual air quality standards and objectives) [19]. In respect of interpretation of the index value, an index value higher than one indicates that for one or more pollutants the limit values are exceeded. Similarly, if the index value is below one it means that on average the limit values are met (see Table 2). Sustainability 2016, 8, 73 6 of 8 Table 2. Interpretation of the index values. Index Value Air Quality >1 The EU standards are exceeded by one pollutant or more 1 The EU standards are fulfilled on average 1 The EU standards are exceeded by one pollutant or more 1 The EU standards are fulfilled on average 1, priority should be given to reducing emissions in the near term, since those areas are suffering the most from air pollution. ii. For locations with the index value = 1, air quality should be improved in order to keep ambient concentrations below an index value of 1. It is particularly important for those areas where health impacts are most likely occurring. iii. For locations with the index value < 1, efforts should be led to maintain the relatively clean air by curtailing new emission sources that could impact health. After setting the goals, comprehensive clean air action plans should be developed and ensure that they are implemented effectively and efficiently. Figure 4. Air quality index for 20 air quality monitoring stations in Turkey. According to the index values, in general, the air quality monitoring stations located at the big cities of Turkey could not fulfil the EU standards. The area with the worst air quality was Manisa-Soma (S19) while best air quality was observed in ˙Izmir-Bornova (S14) (see Figure 4). This is an expected result since there are six coal-fired thermal power plants operating close to S19 air quality monitoring station, while there is no energy system nearby S14. The index results provide a general overview of the air quality situation in a given location all the year through and compare to European norms. The regulations taken into account are some of the annual standards and objectives defined by the European directives. This index is aimed at better taking into account long-term public exposure to air pollution and it can be used as a way of setting air quality goals. i. For locations with the index value > 1, priority should be given to reducing emissions in the near term, since those areas are suffering the most from air pollution. ii. For locations with the index value = 1, air quality should be improved in order to keep ambient concentrations below an index value of 1. It is particularly important for those areas where health impacts are most likely occurring. iii. For locations with the index value < 1, efforts should be led to maintain the relatively clean air by curtailing new emission sources that could impact health. After setting the goals, comprehensive clean air action plans should be developed and ensure that they are implemented effectively and efficiently. 5. Conclusions Environment has had a relatively low priority in Turkey and environmental concerns have been too often superseded by economic growth interest in policy-making. Despite attempts to reduce Sustainability 2016, 8, 73 7 of

8 emissions of air pollutants, air pollution in Turkey is still considered a serious problem and large parts population are currently exposed to concentrations of air pollutants far above the EU limit values. To meet the basic requirements for an efficient air quality control, it is essential to provide measurements and data sufficiently accurate and representative on both time and space, adopting evaluation and monitoring strategies capable. In this context, the National Air Quality Index of Turkey launched in 2007. This real-time index has been developed by modification of EPA Air Quality Index according to national regulations and limit values. This study presents a new approach to evaluate and compare the pollution concentrations in different cities to assess their air quality. In this paper, we have developed a long-term multi-pollutant air quality index for Turkey in view of the EU annual norms. Focusing the annual mean ambient air concentration of SO2, NO2, and PM10, the proposed index evaluate and compares air quality of 20 locations in eight cities. The index provides a relative measure of the annual average air quality in relation to the European limit values, since the target was selected as the EU annual air quality standards. It is aimed at better taking into account long-term exposure to air pollution based on distance to the target set by the EU annual norms. Since those norms being linked most of the time to recommendations and health protection set up by World Health Organization, the proposed index provides a viable option for identifying the overall air quality is poorest and potentially presents the greatest health risk. The index could be also useful as other long-term indices to attract funding from organizations such as the World Bank and the EU to fund the introduction of specific mitigation strategies, which could have benefit of reducing air pollution from cities to other regions. While the lack of air quality data for several cities and pollutants constraint the current effort, the proposed index can also take account other pollutants when data become available. Then the index will facilitate the evaluation and ranking of city emissions and air quality. Although the proposed evaluation framework was applied to only limited number of Turkish cities, this framework is applicable to other countries. We hope that this study will encourage other researchers to apply the evaluation framework to different countries and motivate required improvements to increase air quality of the overall world.
6 Link with national/ sectoral investment plans EU Integrated Environmental Approximation Strategy (UCES) covering the period 2007-2023 contains the information on pertaining to the technical and institutional infrastructure, the environmental improvements that are required to be performed as well as the mandatory arrangements which are necessary to establish complete harmonization for compliance with EU Environmental Acquis Communautaire and the effective implementation of the legislation which are the two pre-conditions for Turkey to join European Union. This main strategy document is the basic source of the project proposal named as “Institution Building on Air Quality in the Marmara Region” In the preparation of UCES, outputs from the following documents were made use of; “National Environmental Strategy and Action Plan” that was prepared as a basis beforehand and the “Integrated Approximation Strategy Project” that was realized with the EC funds and the “Environmental Heavy Cost Investment Planning Project”. Furthermore, care was taken to make sure that the strategy paper was prepared in line with the Development Plan, Annual Programs, and the strategies and policies of the National Program. Under the Air Quality title of UCES (ANNEX 4-4) is mentioned that Air Quality Framework Directive and its daughter directives have priority in the investment stage. The monitoring equipment, measurement systems and quality assurance systems must be installed for the implementation. The responsible institutions on the subject are the Ministry of Environment and Forestry and the Ministry of Health. In the establishment of the limit values, especially with the utilization of the best techniques to be applied in the industrial facilities the costs related with changing the production processes will be covered by the industrialists.

In accordance with the project for the planning of the heavy cost environmental investments, it is foreseen that in total 206 air quality measurement stations have to be installed in Turkey in general. From these stations 123 of them will be in intensive residential areas, 40 will be in the areas where the industry is intensive, 12 will be in the areas where the traffic is intense and 31 will be located in the rural areas. This number will be finalized as a result of the preliminary work to be conducted. Until year 2012 it is required for the preliminary work for the whole of Turkey must be concluded and the monitoring system must be established. The total cost forecasted for the establishment of the monitoring system is 11 million Euros. The total cost of the preliminary studies for air quality is 6 million Euros. Furthermore under the chapter for Air Quality of UÇES- Table (ANNEX 4-4) cost calculations for the following elements were made and these will be considered as additional costs; establishment of the calibration laboratories, establishment of the national calibration center, establishment of the monitoring network management center, national data center, formation of the emission inventories, preparation of the clean air plans, preparation of the action plans, implementation of the plans and programs for the improvement of the air quality, informing the public, reporting and the related personnel costs. In accordance with the project for the planning of the high cost environmental investments, it is foreseen that in total 206 air quality measurement stations have to be installed in Turkey in general. From these stations 123 of them will be in intensive residential areas, 40 will be in the areas where the industry is intensive, 12 will be in the areas where the traffic is intense and 31 will be located in the rural areas. This number will be finalized as a result of the preliminary work to be conducted. Until year 2012 it is required for the preliminary work for the whole of Turkey must be concluded and the monitoring system must be established. The total cost forecasted for the 5 establishment of the monitoring system is 11 million Euros. The total cost of the preliminary studies for air quality is 6 million Euros. In accordance with UCES, it is foreseen that total cost will come up to 37 Million Euro between the period of 2007-2023 for air quality investment needs including the establishment of the monitoring system, the maintenance cost, and operating costs and preliminary assessments. 3. Description of project 3.1 Background and justification: Background; In the past, some indicative air quality measurements and investigations were already done in Turkey. A National network system has been built up for measuring SO2 and PM10 parameters by the MoEF and Refik Saydam Hygiene Centre (RSHC). The air quality management system in Turkey involves several ministries which are MoEF and MoH and national institutions which are, The Scientific and Technological Research Council of Turkey (TUBITAK), RSHC and furthermore several municipalities and to some extent universities. The air quality in the country in general is measured by using the semi-automatic measurement devices that belong to the Ministry of Health. The collected data are evaluated and reported to the related authorities by the Ministry of Health, Refik Saydam Centre of Hygiene. The fully automated air quality measurement stations were established in 81 provinces by the Ministry of Environment and Forestry. The national network of the MoEF measures only two parameters, namely the components of sulphur dioxide (SO2) and particulate matter (PM10). Gölbaşı Reference Laboratory as a related institution of the MoEF is responsible for the evaluation of the air quality data and management of the National Air Quality Network. The preparation of new measuring techniques, approval of measuring devices and methods, calibration and basic metrology at international level and establish a national measurement system and provide services to the laboratories within this system in terms of calibration, training, consultancy and other mechanisms are in the responsibility of the National Metrology Institute (UME) which is semi-autonomous institute under TÜBİTAK. With the purpose of harmonization of EC legislation on air quality to a framework legislation a Twinning

Project named “Support to Turkey in the field of Air Quality, Chemicals and Waste Management’’ was started in year 2004, and with the first component of this Project, the Air Quality, it is aimed to transpose Air Quality Framework Directive to our National Air Quality Legislation and to the activities for measuring the air quality, and the transposition of the provisions of the Large Combustion Plants Directive to our legislation. The project is completed in 2006 Draft By-law on Air Quality Assessment and Management (BAQAM) and to limit emissions arising from large combustion plants, Draft By-Law on Large Combustion Plant prepared. Those drafts were submitted for the approval to the related authorities of the Turkey. In addition, strengthening of the qualification of the administration and of the technical structures in the administration (Know – How –Transfer) and strengthening of the quality management and preparation of the accreditation of the two laboratories - Refik Saydam Hygienic Center (RSHC) and Gölbasi were achieved under the project. Parallel to the Twinning project, there was an investment component of the project, which supplied Refik Saydam Hygienic Center (RHSC)with 8 measurement stations for the city of Ankara, a calibration laboratory, transfer strandards etc. In 6 connection with emission and ambient air network measurements, the laboratory and MoEF staff which participated in the trainings became aware of the need for maintenance and calibration procedures. Furthermore, Strategy For The Implementation And Enforcement of The By-Law On Air Quality Assessment and Management was prepared. Full text of Strategy document is in available in ANNEX-4.2. The Draft By-law on Air Quality Assessment and Management covers four daughter directives (99/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC) besides Air Quality Framework Directive, 96/62/EC. The new draft by-law sets the implementation calendar for implementation and harmonization of 13 pollutants that are defined under the framework directive and the daughter directives. By-law also aims to strengthen the monitoring, sanctioning and institutionalization in the area of controlling the pollution and air quality. BAQAM will be taken into force until end of 2007. In case the new air quality limit values which are indicated in BAQAM, are exceeded. A strategy is required to reduce ambient air pollution concentrations. In this framework, Strategy For the Implementation and Enforcement of the By-Law on Air Quality Assessment and Management requires a new structure both at the national and regional level. Some new working units are needed to fulfil the new tasks. These working units and their responsibilities are explained in Strategy document in ANNEX-4-2 There is a need for a clear-cut assignment of the responsibilities for the execution of air quality directives to institutions. Clear-cut assignment also will support well-functioning air quality assessment and management as well as clean air policies in Turkey. An important step had been done into this direction by the renovation of the Turkish Environment Law. An amended Environment Law has passed in the parliament in May 2006, in which the responsibilities of ministries and institutions involved in air quality were redefined. The Environment Law introduces methods about the determination, monitoring and measurement of air quality and air quality limit values and measures to be taken to prevent exceeding of limit values. Also, The Environment Law determines the MoEF as the primary responsible authority for environmental issues, such as increasing public awareness and providing access to related information. In this regard, the capacity of MoEF should be increased for the implementation of AQFD. Justification; The MoEF should coordinate the existing facilities of the related authorities (governor and provincial directorate of MoEF), of the municipalities and the RSHC and establish the infrastructure in a region to ensure the quality of the data, to build up an emission data base and to introduce a model to be able to provide a preliminary assessment (and later the yearly assessments), prepare clean air and alarm plans and introduce measures to improve the air quality where necessary and inform the public. UCES Document defined comprehensive coordination role for the

Ministry of Environment and Forestry in Air Quality for adaptation and implementation of EU Directives The project with headline “Environmental Heavy Cost Investment Planning Project” was launched in the framework under 2002 European Union Financial Cooperation Programme and finished by the end of 2005. Among others, the consequences of implementation of the air quality framework 7 directive were evaluated and estimated in terms of necessary investment costs. Furthermore, UÇES and other EU funded projects, the Twinning Project in Air Quality addressed new project proposal which will give opportunity to establish necessary capacity for the implementation of EU Acquis in Air Quality in a region. Particularly, Strategy Paper prepared under Twinning Project (ANNEX-4-2) has revealed the necessities of Turkey in field of air quality and determined related technical and financial requirements in regional base . Results of the project will be the example and experience for the other regions to implement the EU Air Quality Framework and Daughter Directives. In the framework, for the adaptation of theoretical studies into practice, Marmara Region was chosen. based on the experience in Turkey, such an air quality management plan according to the requirements by the EU legislation should first be performed in the “Marmara” region serving as a model region for Turkey. In addition, the gaps in this rather incomplete system need to be filled in Marmara region. The system should be built in the region fulfilling all the technical and administrative requirements of the AQFD and the reporting requirements of the LCPD. The Marmara Region has developed extremely rapidly over the last twenty years and as a result it become one of the most industrialized and highly polluted area. The population in the region is estimated to be approximately 20 million. Istanbul, Kocaeli and Bursa, like other highly developing countries, are the “prior cities” for Turkey and have received the majority of the growth. The growth has been realized with little or no planning. The rapid industrialization, high population growth and low urban infrastructure have huge effects on the air pollution in the region. In this regard, the “Marmara Project” is a good model for monitoring of all sources of air pollution such as industry, traffic and heating. In this framework, it is essential to establish a comprehensive air quality-monitoring network for defining the scale of the air pollution problem and minimizing the problem. For Turkey, it is not easy to overcome bottlenecks in the implementation of AQFD requirements in such a huge area without EU expertise. The project will bring a new assessment and management approach in line with EU Ambient Air Quality Directives for solving air pollution problem and its potential effects on human health. Furthermore, this project will give a chance to use the existing infrastructure with equipments (10 air quality measurement stations in Istanbul and 2 stations in Bursa) and to benefit from human resources training. This project would also enable the decision makers and local authorities to evaluate the effectiveness of air pollution minimization strategies and clean air plans / action plans. For this purpose Regional Centre for Clean Air includes Regional Ambient Air Network, Regional Calibration Laboratory (RCL), Regional Data Centre (RDC) and Regional Maintenance Centre(RMC). RCL should ensure the use of the national calibration standard in the respective regional network. RDC also need to be established in the region, which transmits the data to the National Data Centre. RMC should be established for maintenance of equipment and to provide system operating properly. In Regional Ambient Air Monitoring Center, 21 Turkish experts from different disciplines will take responsibility in monitoring network operation, regional calibration laboratory, regional data center, analytical laboratory, regional unit for analysis and modeling action (ANNEX 5-5). They should be situated in Istanbul together with the Resident Twinning Advisor. The MoEF offices in Istanbul and the other 10 provinces (Kocaeli, Bursa, Balıkesir, Sakarya, Çanakkale, Yalova, Tekirdağ, Edirne, Kırklareli, Bilecik) should participate the project. The 8 meetings regularly held to execute the project with the responsible persons from the MoEF in

Ankara, the MoEF provincial offices and municipalities in the Marmara region. Most of the activities will take place in the region. The project enables to fulfill the AQFD in the region and will be a model for the other regions. In addition to the administrative requirements; in order to increase the technical capacity of the ambient air quality monitoring system in the Marmara region, 39 air quality measurement stations have to be installed and to ensure the fulfilment of the Framework Directive 96/62/EC and its daughter directives. From these stations 19 of them will be established in intensive residential areas, 7 will be established in the areas where the industry is intensive, 9 will be established in the areas where the traffic is intense and 4 will be located in the rural areas. These distribution is given in ANNEX-4-1- (Table-1, Table-2, Table-3). The details of the equipments in Air Quality Monitoring Network is also given in ANNEX 5-3 . The staffs from the departments of the MoEF that are responsible from control, management and monitor of the air quality in Ankara, will attend in whole steps of implementation of the project Investment costs for Regional Ambient Air Network including Regional Data Centre and Regional Maintenance Centre, Calibration Laboratories RCL and particle determination and Analytical Laboratories, Basic Emission Data Base and first preliminary assessment for the region in Marmara region is totally equal to 5,180 M Euro (ANNEX-5-2). The Regional Centre for Clean Air in İstanbul with building and staff will be secured by the MoEF before the project starts. The operating costs will be timely started with the project. But, the full laboratory equipment of this centre will be established by this project. The proposed project concerning Institutional Building including Technical Assistance in Air Quality in Marmara region should be carried out under the supervision and patronage of the MoEF as the main administrative body for the air quality issues. This work needs to be carried out in cooperation with the municipalities of the selected region (Istanbul/Bursa for the Marmara region), the RSHC, the Gölbaşı Reference Laboratory and TUBITAK. The Provincial Directorates of the MoEF in the region, metropolitan municipalities, universities, chambers etc. are the other beneficiaries of the project. Such a project would need to be started in 2008 and be ended at latest in 2012 in order to provide for the implementation of its results (Clean air plans, action plans) in the remaining zones and agglomerations of Turkey by 2015. The total budget of the Marmara Project is estimated to be 7, 080 M Euro including for institutional building 1,9 M Euro (under Twinning –ANNEX 5.4)and for investments 5,180 M Euro. The quarter percentage of the investment costs that means 1,295 M Euro will be provided from the national budget of Turkey. The contribution of the EU to investment cost will be 3, 885 M Euro. Services: The cost modelling of preliminary assessment for the region and also basic emission data base are taken into account under the supply component of the project. But, the training for the modelling are planned from the private companies under the supply component which is estimated around 200,000 Euros which should be able to be split up into three parts since three different kind of models have to be considered (street modelling, point and area source modelling and the big EURAD model) so it may be that three different companies could be employed. 9 The same is true for the investment part for the models (it should be able to be split into three parts). And also the trainings should be bought from the companies which do the corresponding model calculations. In addition 100 thousand Euros should be available for the training of the emission data bases. 3.2 Assessment of the project impact, catalytic effect, sustainability and cross border impact Air quality management plan according to the requirements of the EU Legislation will be performed in the ‘Marmara’ region as a model region in Turkey. It is essential to introduce a comprehensive system, to build up a Regional Centre for Clean Air, which includes a regional ambient air network. The network will also include a Regional Calibration Laboratory, Regional Data Centre and Regional Maintenance Center. This project will bring positive effects in terms of providing the

necessary communication between the authorities and defining responsibilities in the region. MoEF (Provincial Directorates of MoEF) will be responsible from the coordination and communication among the authorities. Implementation Chart of the project is given in Figure-1 in ANNEX-3. As seen from the figure, many of the stakeholders in the region will take part in the project. This project will create a chance for the implementation of AQFD in a huge industrial area, such as Marmara region and will provide a catalytic effect with regards to the implementation of the AQFD throughout Turkey. For sustainability of such a comprehensive system; For equipments Education Programme for the staff should be organized Manuals should be prepared for the further usage of equipments. Maintenance of these equipments and measurement stations should be ensured Necessary mechanism by project team should be established for expenditures of the equipment and stations For basic emission data Maintenance of the measurement stations should be supplied. Data Quality Assurance System should be established. For the usage of models Education Programme for the staff should be organized Guidelines should be prepared For the monitoring of air pollutants Clean air plans, alarm plans, action plans should be prepared Awareness of the public should be increased by the way of media, brochure etc. For each item listed above workshops and seminars should be organized for increasing awareness. 3.3 Results and measurable indicators: The results expected from the project are as follows; 1- For the implementation of AQFD and daughter directives in a regional level Regional Ambient 10 Air Quality Monitoring System was established and operated. Measurable indicators are; 1.1- 39 (At least) air quality measurement stations and necessary equipment and calibration laboratory were established by the end of 2011. 1.2- 30 Turkish Experts were trained for management/ operation of regional ambient monitoring network by the end of 2011. 1.3- Equipment, emission data base and model results were delivered, 30 staffs were trained by the end of 2011. 1.4- Regional Calibration Centre, Regional Data Centre and Regional Maintenance Centre were established until the end of 2011. 2- For the implementation of the AQFD and daughters directives requirements the development of the institutional and technical capacity was ensured. Measurable indicators are; 2.1- 40 staffs from MoEF (regional, Gölbasi, RCCA) and RSHC were trained on data analysis, source analysis, modelling, emission data base, reporting by the end of 2011 2.2- 30 MoEF (regional/ Gölbasi, RCCA,RSHC) staffs were trained in Data Quality Assurance by end of 2011 2.3- 40 MoEF (Regional/Golbasi, RCCA), RSHC staffs were trained in and assigned to ambient air quality monitoring network by the end of 2011 2.4- 10 MoEF staffs were trained in modeling work by the end of 2011 2.5- Both MoEF and RSHC each undertake review in 2008 and again at the end of 2011 to assess improvement 2.6- Clean air plans, action (alarm) plans were adopted by the end of 2011. 3-. Awareness of priority groups and decision makers were raised. Measurable indicators are; 3.1- 5 Workshops and 10 seminars were done together with all stakeholders (provinces, municipalities, universities, chambers, NGOs, etc.) until the end of 2011 3.2- Web-site was prepared to share the activities of the project and to share measurement results a few months after the project started. 3.4 Activities: The Project activities will be achieved under Twinning and Supply Contract separately. The following activities will be achieved under Supply Contract due to payment procedure. 11 For the implementation of AQFD and daughter directives in a regional level, Regional Ambient Air Monitoring System were established and operated. In order to achieve this result, the following activities are needed. 1.1-The procurement of a basic emission data base in the region and strengthening of the capacities in this field 1.2- The procurement of air dispersion modelling capacity. 1.3-The procurement of basic model results for the region as a basis for preliminary assessments, yearly assessments, clean air plans, alarm plans and measures for clean air and strengthening of the capacity to work in this field. 1.4 - The procurement of a regional emission data base which should be the basis for the

continuous update carried out by the regional centre for clean air and for modelling and reporting purposes – considering topographic and meteorological conditions – considering the requirements of the IPPC and LCP Directives 1.5- The procurement of equipment for the regional network(calibration laboratory, measurement stations, computer (hardware and software)- preparations for the measurement of the wind field in this region (methods-equipment) 1.6-The procurement of missing equipment (e.g. calibration laboratory, stations, computers, etc.) in the region Under Twinning Contract two main results to be achieved. Firstly, for the implementation of the AQFD and Daughters directives requirements, the development of the institutional and technical capacity is ensured 2.1- Identifying infrastructure for implementation of the AQFD and Daughter Directives requirements in the region 2.2-Evaluation of institutional and technical capacity (existing structure/equipments) for the implementation of the AQFD and Daughters requirements in the region. 2.3-Coordination and cooperation among stakeholders in the region for preparation of emission inventory 2.4-Preparation of technical specifications for equipments /hardware/software measurement stations etc. 2.5- Supporting MoEF and CFCU in procurement process of supply tender. 2.6-The running of existing models for the emission of point and area sources and the EURAD model for Turkey demonstrated for the region 2.7- Assistance of the Quality assurance methods for the field and laboratory activities of the Golbasi Laboratory , Refik Saydam Hygiene Centre (RSHC) and a New Regional Centre 2.8- Assistance of a network of the air quality assurance system in connection with the Ankara 12 Network (RSHC) and the National Network (Gölbasi / MoEF) and further existing municipality networks and TÜBITAK as the provider of the primary standards (e.g. first national round robin test) 2.9-Implementing the AQFD including field , laboratory and office procedures review on the regional scale 2.10-Detailed training both in Turkey and in Member States 2.11-Dissemination workshops on practical implementation of AQFD 2.12-Increasing the personnel capacity of staff working in the region . 2.13- Draw up of clean air plans, action (alarm) plans for the selected area 2.14-Preparation of guidelines on Preliminary assessment and Clean Air Plans 2.15- Provision of assistance and training during the accreditation of laboratory. Another important result under Twinning is to increase awareness of priority groups and decision makers. In order to achieve this result, the following activities are needed. 3.1-Sharing experiences of this region with neighbour provinces in other zones by workshops, seminars, published papers etc. 3.2-Training of trainers for national and local experts for the implementation of the AQFD throughout Turkey. 3.3- Assistance with public information in connection with clean air plans and action (alarm) plans. 3.4-Preparation of Website. 3.5-Preparation of brochure. 3.6-Introduction of Project activities on local TV Channels 3.5 Conditionality and sequencing In 2007 it is planned to enter into force of the draft of Turkish legislation considering the AQFD and the Daughter Directives. Regional Ambient Air Monitoring Network has to be established in the Marmara Region. Estimated staff resources required for a Regional Centre for Clean Air is to be composed of approximately 21 Turkish experts. (ANNEX-5-5). The Regional Centre for Clean Air in İstanbul with building and staff will be secured by the MoEF before the project starts. The operating costs will be timely started with the project. Provincial Directorates of MoEF will have responsibilities for operating Regional Ambient Air Monitoring Network. Since, there is no national or regional environmental agency yet, this group should be acting under the supervision and patronage of the MoEF with the coordination of the MoEF branch in Istanbul and the MoEF branches in other provinces of the Marmara Region. 13 Support to the procurement of the equipment can be started based on an assessment of the existing stations, networks, capacity etc. in the region. Coordination of quality assurance for the existing networks shall start with the help of the calibration laboratory of the Ankara network of RSHC. The other activities

such as field procedures, laboratory procedures, and office procedures review on the regional scale and trainings will start accordingly. The delivery date of laboratory equipments, measurement stations, computers and building will be in different time intervals. In this stage, it is very difficult to define the linkages between separate contracts. Sustainability of such a comprehensive system (maintenance of laboratory equipments, measurement stations, computers etc.) and maintenance of the supplies should take into warranty of contractor for a certain period (such as 2 or 3 years). But for the following years, Regional Maintenance Centre work under Regional Centre for Clean Air will have responsibility for maintenance of equipment. MoEF will be responsible authority from the sustainability of Regional Ambient Air Monitoring System.